MN DEPARTMENT OF HEALTH

Monitoring Plan
UNREGULATED CONTAMINANTS MONITORING PROJECT

Background and Purpose

The Minnesota Department of Health (MDH) received a grant from the Minnesota Environment and Natural Resources Trust Fund (ENRTF) in July 2018 to conduct monitoring at public drinking water systems. The goals of this project are to: 1) characterize the presence of selected unregulated contaminants in drinking water sources and associated samples of treated drinking water in Minnesota; and 2) identify screening approaches to simplify and target future monitoring efforts.

Broadly speaking, drinking water in Minnesota comes from either groundwater or surface water. The monitoring approaches described in this plan will apply to both types of source water. Prior work in Minnesota and elsewhere has established that different classes of unregulated contaminants (e.g., pharmaceuticals, pesticides, etc.) are derived from different land uses. Key land uses of concern in Minnesota are those subject to agricultural operation and, separately, those affected by wastewater disposal. While there is some overlap, the types of unregulated contaminants that come from agricultural land uses differ from those subject to wastewater disposal. Consequently, we created separate monitoring networks for wastewater and for agricultural land uses. Site selection criteria and parameter selection for these networks are described below (see Table 1, Figure 1).

Monitoring will consist of sample collection from drinking water sources, as well as from other selected sampling points within the drinking water system, and analysis of the samples using several different approaches. Screening techniques and targeted laboratory analytical approaches will be used to characterize water quality. The sampling and analysis approaches described in this plan are limited by the time frame and budget laid out in the original grant.

Site Selection

Site selection criteria were developed separately for each network. A set of prospective sampling sites have been defined for wells that may have been affected by wastewater and by agricultural land uses. We expect that some of these sites will not be sampled for any number of unforeseen circumstances, but we plan to sample approximately 30 wells for each network. An additional 17 surface water sites will be sampled. Each sample from either a groundwater or surface water source will be accompanied by a sample from the distribution system entry point, as defined by the community public water system. Accordingly, a total of approximately 200 samples will be collected and analyzed for this study.

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND

Agricultural network

The following considerations were used to select prospective sample sites:

- Prior water quality conditions
  - Elevated nitrate
  - Detections in 2015 MDH/Minnesota Department of Agriculture (MDA) Pesticide study
  - Groundwater Virus Monitoring study results indicating the presence of bacteria or viruses associated with livestock or manure
- Land use in drinking water supply management area for well
- Measures in wellhead protection plan directed at agricultural land uses
- Geographical diversity

Wastewater network

The following considerations were used to select prospective sample sites:

- Water quality indicative of wastewater influence
  - Cl/Br ratio between 500 and 800, with chloride between 40-100 mg/L
  - Bacteria positive water quality result
  - Groundwater Virus Monitoring study results
  - Prior pharmaceutical or artificial sweetener detection
- Known wastewater sources in drinking water supply management area for well
  - Wastewater treatment plants
  - Subsurface sewage treatment systems/residential septic
  - National Pollutant Discharge Elimination System (NPDES) permits
  - Sewer infrastructure

Surface water network

There are 24 community public water systems in Minnesota. All of these will be sampled except for several of the systems that use Lake Superior, the Red Lake River, and mine pit lakes as a source of supply.

Parameter Selection

General Considerations:

1. Association of compounds with wastewater disposal or agricultural land use activities, tailoring the parameters to the setting being sampled.
2. Results from prior studies. Preference given to characterizing presence of compounds found in previous work in groundwater or surface water in Minnesota, or nationally.
3. Availability of resources.
   For example, study design does not lend itself to multiple sample selection events, at a short frequency, as would be required to fully characterize compounds that may exhibit short term or seasonal/climatic dependencies.

4. Technology or laboratory analytical limitations.
5. Availability of prior studies that are specific to drinking water. For example, the MDH Groundwater Virus Monitoring study, the 2015 MDA/MDH Pesticide Study, and ongoing cyanotoxin work by St. Paul Regional Water Services.
6. Compounds that are of current public health interest or concern (i.e. per- and polyfluoroalkyl substances (PFAS), iopamidol).

Agricultural network

Parameters that were chosen for the agricultural network were selected, in addition to the considerations listed above, based on their association with agricultural land use. Detection of these parameters will serve as an indication that chemicals involved in agricultural activities at the land surface are reaching the aquifers below and impacting the public water supply wells. These compounds primarily include pesticides.

Wastewater network

Parameters that were chosen for the wastewater network were selected, in addition to the considerations listed above, based on their association with wastewater disposal. Detection of these parameters will serve as an indication that compounds in human waste and wastewater are reaching the aquifers below and impacting the public water supply wells. These compounds include pharmaceuticals, personal care products, specific wastewater indicators, and PFAS.

Surface water network

The surface water sites contain the most vulnerable water supplies of the three sampling networks included in this study, as such, the parameters selected for the surface water network consist of the parameters selected for both the agricultural and wastewater networks, as well as additional parameter groups. These additional parameters include benzotriazoles, illicit drugs, alkyl phenols and alkyl phenol ethoxylates, hormones, and an expanded array of pharmaceuticals and personal care products that are more broadly detected in surface waters.

Scheduling

Sites included in the agricultural network and wastewater networks will be sampled one time during the summer of 2019. Surface water sites will be sampled twice during the summer of 2019. All site visits will include coupled samples from both the source (raw water) and finished water.

Quality Assurance/Quality Control

Quality control samples will be collected at approximately 10% of all sites within each sampling network. These will include a mixture of field blanks and duplicate samples, as well as trip blanks.
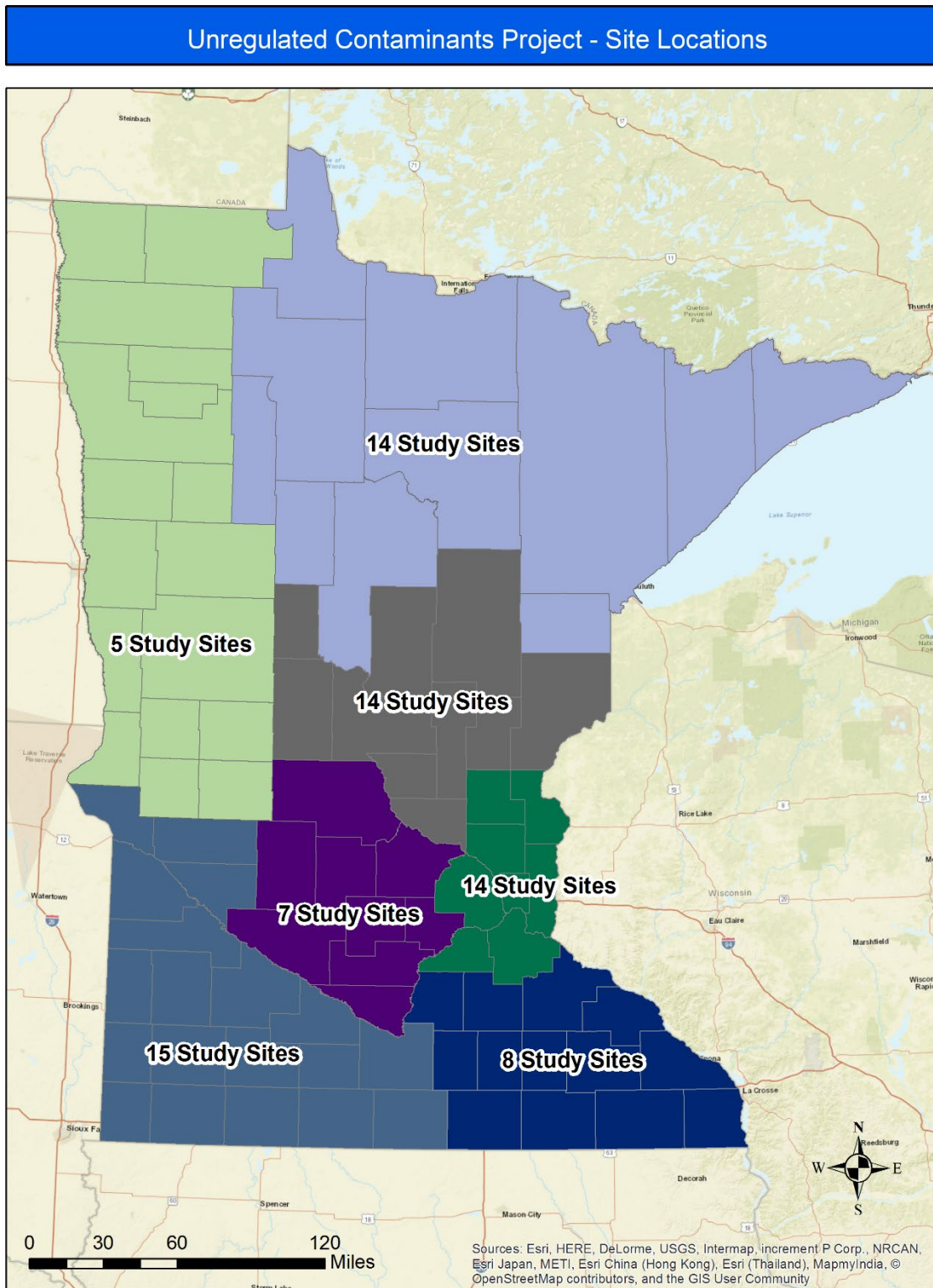
Table 1. Parameter Selection by Network

Parameter Group	Lab	Agricultural Network	Wastewater Network	Surface Water Network
General water chemistry	MDH	X	X	X
ELISA[1] Pharmaceuticals	USGS[2]		X	X
ELISA Pesticides	USGS	X		X
Wastewater indicators	USGS NWQL[3]		X	X
Pharmaceuticals	USGS NWQL		X	X
PFAS	AXYS		X	X
Benzotriazoles	MDH			X
Illicit Drugs	MDH			X
Pharmaceuticals and Personal Care Products (Lists 1, 6)	AXYS		X	
Pharmaceuticals and Personal Care Products (Lists 1, 3, 6)	AXYS			X
Alkyl Phenols and Alkyl Phenol Ethoxylates	AXYS			X
Hormones	AXYS			X
Pesticides	USGS NWQL	X		X

[1]Enzyme-linked immunosorbent assay; [2]U.S. Geological Survey; [3]National Water Quality Laboratory

Figure 1. Study Sites by Region

Unregulated Contaminants Project - Site Locations

14 Study Sites

5 Study Sites

14 Study Sites

7 Study Sites

14 Study Sites

15 Study Sites

8 Study Sites

Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

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